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Indian Standard

SPRING-OPERATED IMPACT-TEST APPARATUS AND ITS CALIBRATION — SPECIFICATION

UDC 620·178·7·05 : 681·2·089·6

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Electrical Appliances Sectional Committee, ETD 32

NATIONAL FOREWORD

This Indian Standard, which is identical with IEC Pub 817 (1984) 'Spring-operated impact-test apparatus and its calibration' issued by the International *Electrotechnical Commission (IEC)* was adopted by the Bureau of Indian Standards on the recommendation of the Electrical Appliances Sectional Committee (ETD 32) and approval of the Electrotechnical Division Council.

CROSS REFERENCE

International Standard	*Indian Standard*	*Degree of Correspondence*
ASTM Specification D785-65 (reapproved in 1981) Determination of the Rockwell hardness of plastics	IS 13360 (Part 5/Sec 13) : 1992	Equivalent

In the adopted standard certain terminology and conventions are not identical with those used in Indian Standards; attention is specially drawn to the following:

a) Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standard, the current practice is to use a point (.) as the decimal marker.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed, or calculated, expressing the result of a test, or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Only the English language text in the International Standard has been retained while adopting it in this Indian Standard.

Indian Standard

SPRING-OPERATED IMPACT-TEST APPARATUS AND ITS CALIBRATION — SPECIFICATION

1. Scope

This standard describes the construction, the application and the calibration of the spring-operated impact-test apparatus used for checking the mechanical strength of electrical equipment by applying blows to the specimen to be tested.

2. Construction

The spring-operated impact-test apparatus is shown in Figure 1, page 14. The apparatus consists of three main parts, the body, the striking element and the spring-loaded release cone.

The body comprises the housing, the striking element guide, the release mechanism and all parts rigidly fixed thereto. The mass of this assembly is 1250 ± 10g.

The striking element comprises the hammer head, the hammer shaft and the cocking knob. The mass of this assembly is 250 ± 1g.

The hammer head has a hemispherical face of polyamide having a Rockwell hardness of HR 100, with a radius of 10 mm. The hammer head is fixed to the hammer shaft in such a way that the distance from its tip to the plane of the front of the cone, when the striking element is on the point of release, has approximately the value shown for the spring compression in the table hereafter.

The cone has a mass of 60 g and the cone spring is such that it exerts a force of approximately 5 N when the release jaws are on the point of releasing the striking element. The release mechanism springs are adjusted so that they exert just sufficient pressure to keep the release jaws in the engaged position. The pressure required to release the striking element must not exceed 10 N.

The configuration of the hammer shaft, the hammer head and the means for the adjustment of the hammer spring is such that the hammer spring has released all its stored energy approximately 1 mm before the tip of the hammer head passes the plane of impact.

For the last millimetre of its travel prior to impact, the striking element is thus, apart from friction, a freely moving mass having only kinetic energy and no stored energy. Moreover, after the tip of the hammer head has passed the plane of impact, the striking element is free to travel, without interference, over a further distance of at least 8 mm.

The impact-test apparatus is calibrated as described in Clause 4, so that, when the apparatus is held in the horizontal position, the kinetic energy of the striking element just before impact has a value as specified in the table on page 9.

The apparatus is cocked by pulling the cocking knob until the release jaws engage with the groove in the hammer shaft.

Information concerning the determination of the Rockwell hardness of plastics is given in ASTM specification D 785-65 (reapproved in 1981). For determining the Rockwell hardness of the polyamide of the hammer head, the following conditions apply:

diameter of the ball	12.7000 ± 0.0025 mm
initial load	100 ± 2 N
overload	500 ± 2.5 N

The value of the kinetic energy just before impact shall be fixed by the relevant Technical Committee.

Kinetic energy just before impact (J)	Approximate spring compression (mm)
0.20 ± 0.02	13
0.35 ± 0.03	17
0.50 ± 0.04	20
0.70 ± 0.05	24
1.00 ± 0.05	28

The approximate value of the kinetic energy E, in joules, just before impact can be calculated from the following formula:

$$E = 0.5\,Fc \times 10^{-3}$$

where:

F is the force exerted by the hammer spring when fully compressed, in newtons

c is the compression of the hammer spring, in millimetres

Attention is drawn to the fact that the actual value of the kinetic energy just before impact is found by the method described in Clause 4.

In order to avoid frequent resetting and recalibration, it is recommended to calibrate a separate apparatus for each value of kinetic energy.

3. Application

The blows of the spring-operated impact-test apparatus are applied by pushing the release cone against the appropriate place on the specimen to be tested in a direction perpendicular to the relevant surface.

The pressure is slowly increased so that the cone moves back relative to the body of the apparatus until it is in contact with the release bars, which then move to operate the release mechanism and allow the hammer to strike.

The specimen as a whole is fixed as in normal use to, or placed against, a rigid plane support.

Before applying the blows, fixing screws of bases, covers and the like are tightened with a torque equal to that applied in normal use.

To ensure that the specimen is rigidly supported, it may be necessary to place it against a plane solid wall of brick, concrete or the like, covered by a sheet of polyamide which is tightly fixed to the wall, care being taken that there is no appreciable air gap between the sheet and the wall. The sheet must have a Rockwell hardness HR 100, a thickness of at least 8 mm and a surface area such that no part of the specimen is mechanically overstressed due to insufficient supporting area.

For small equipment, a concrete block having a mass of at least 15 kg may be used as the rigid support.

The number of blows to be applied to the specimen, the places where the blows shall be applied and the torque for operating screws shall be fixed by the relevant Technical Committee.

4. Calibration

4.1 *Construction of the calibration device*

The main part of the calibration device is the pendulum shown in Figure 2, page 14, to the lower end of which a steel spring is fixed, the spring being detailed in Figure 3, page 15. The spring is of spring steel, hardening of which is not necessary, and is rigidly fixed to the pendulum.

The assembled calibration device is shown in Figure 4, page 15. Apart from the frame, the main parts are a bearing a, a drag pointer b, a release base c and a release device d. These parts are shown on a larger scale in Figure 5, page 16.

In order to obtain suitable friction characteristics of the pointer, a piece of thick woven cloth is placed between the metal surfaces of the bearing, the piano wires being bent in such a way that a small force is exerted against the cloth.

Because the release device must be removed during the calibration of the calibration device, the release device is fixed to the release base by means of screws.

• 4.2 *Method of calibration of the calibration device*

The calibration of the calibration device is effected by means of a separate striking element a, taken from a spring-operated impact-test apparatus, as shown in Figure 6, page 17.

The striking element is suspended by four linen threads b from suspension points situated in a horizontal plane, 2000 mm above the point of contact between the spring c and the striking element when the latter is in its rest position. The striking element is allowed to swing against the spring c and the point of contact under dynamic conditions shall be not more than 1 mm below the point of contact in the rest position. The suspension points are then raised over a distance equal to the difference between both contact points.

When the suspension system is adjusted, the axis of the striking element shall be at right angles to the impact surface of the spring and the striking element shall be horizontal at the moment of impact.

When the striking element is in its rest position, the calibration device is placed so that the point to which the blow would be applied when calibrating a spring-operated impact-test apparatus is positioned exactly at the head of the striking element.

Only the pendulum of the calibration device is shown in Figure 6. A difference of 1 mm in the vertical direction will cause a calibration error of approximately 0.8%.

Before calibration, the release device is removed from the calibration device.

Alternatively, two linen threads may be used for suspending the striking element. To ensure that for this suspension method the axis of the striking element is at right angles to the surface of the spring of the pendulum, the suspension system shall be adjusted so that the striking element, when returning after impact on the spring, follows exactly the same path as before the impact. Moreover, care shall be taken that the thread nearest the head of the striking element is sufficiently far away from the tip of the striking element, so that any interference with the pendulum or the drag pointer is avoided.

To obtain reliable results, the calibration device is rigidly fixed to a support, for example to a constructional part of the building.

The calibration is made with an impact energy of 1 J, which is achieved with a height of fall of 408 ± 1 mm.

The height of fall is measured at the centre of gravity of the striking element and the measurement can be facilitated by using two glass tubes d, which are interconnected by means of a flexible hose. One of the glass tubes is fixed and provided with a scale e.

The striking element may be held in its upper position by means of a thin thread f which, when ruptured, causes the release of the striking element.

For making the scale, a circle is drawn on the scale plate, the centre of this circle coinciding with the bearing point of the pendulum and its radius being such that the circle extends to the drag pointer. On this circle, the zero point 0 J shown in Figure 7, page 17, is marked at that point indicated by the drag pointer when the latter is brought into contact with the pendulum in the rest position.

The point on the scale plate corresponding to 1 J is obtained by allowing the suspended striking element to swing against the point of impact of the spring of the pendulum from a height of 408 ± 1 mm. The operation is repeated at least ten times and the 1 J point is the average of the indications of the drag pointer.

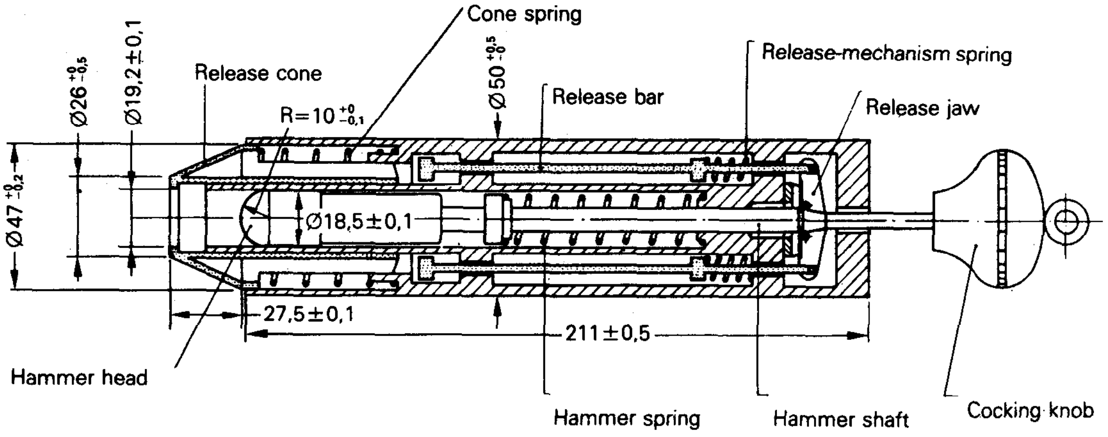
The other points of the scale are then determined as follows: A straight line is drawn through the centre of the circle and the point 0 J. The orthogonal projection of the point 1 J on this line is indicated by P. The distance between the points 0 J and P is divided into ten equal parts. Through each dividing point, a line is drawn perpendicular to the line 0 J – P. The intersections between these lines and the circle correspond to values of impact energy equal to 0.1, 0.2, 0.3 up to 0.9 J. The same principle can be used for extending the scale beyond the point 1 J.

4.3 *Use of the calibration device*

To obtain reliable results, the calibration device is rigidly fixed to a support, for example to a constructional part of the building.

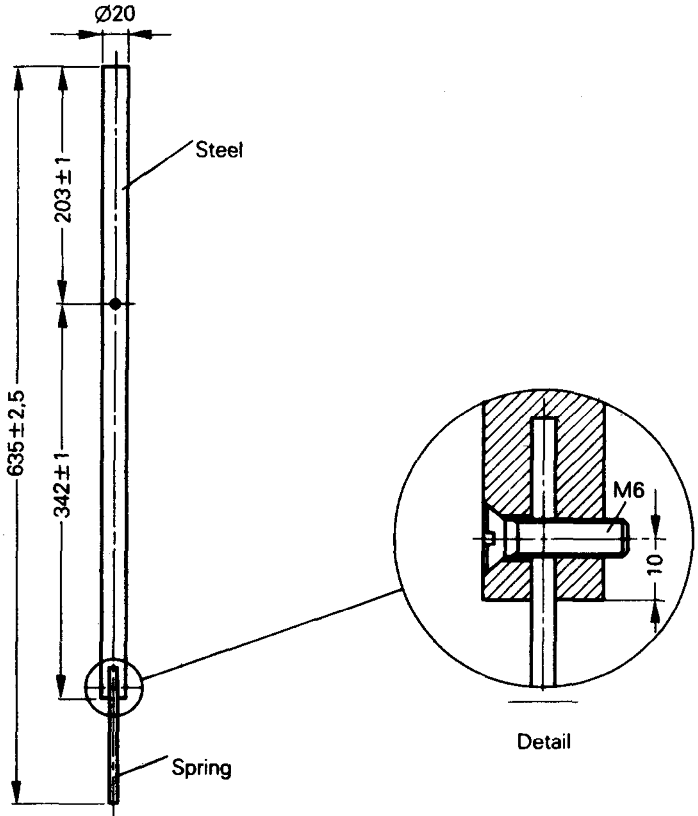
The spring-operated impact-test apparatus to be calibrated is put in the release base and is then operated three times by means of the release device; it must not be released manually.

For each operation, the striking element is turned in a different position. The average value of the three readings on the calibration device is considered to be the actual value of the impact energy of the spring-operated impact-test apparatus.



Rockwell hardness HR 100
Dimensions in millimetres.

FIG. 1. – Spring-operated impact test apparatus.



Dimensions in millimetres.

FIG. 2. – Pendulum.

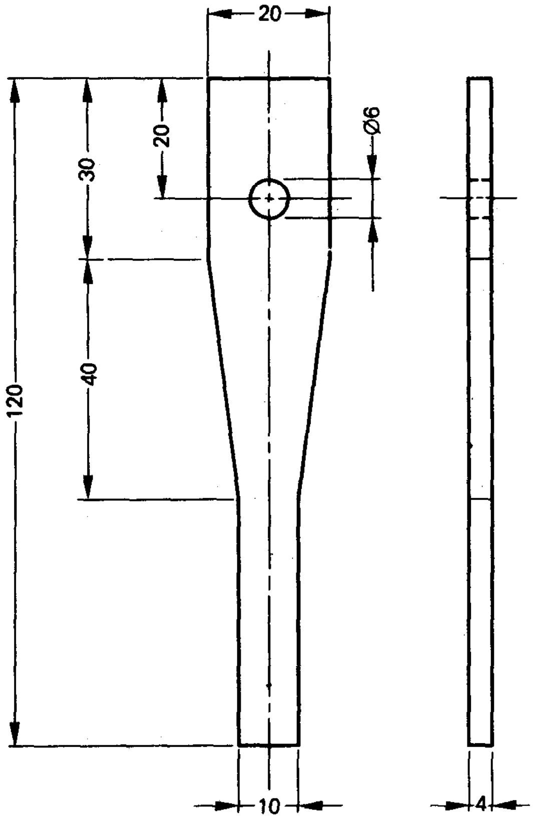


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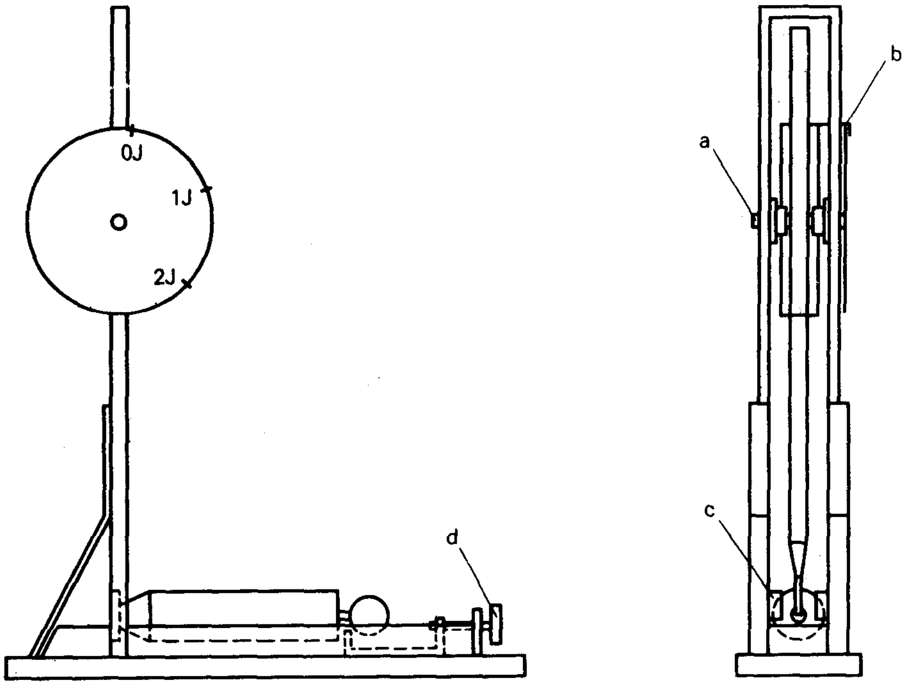
Fig. 3. – Steel spring.

Dimensions in millimetres.



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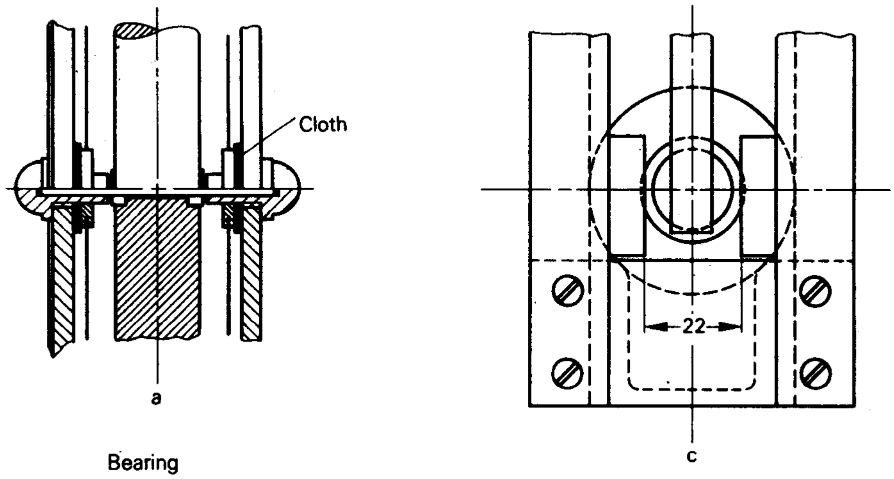
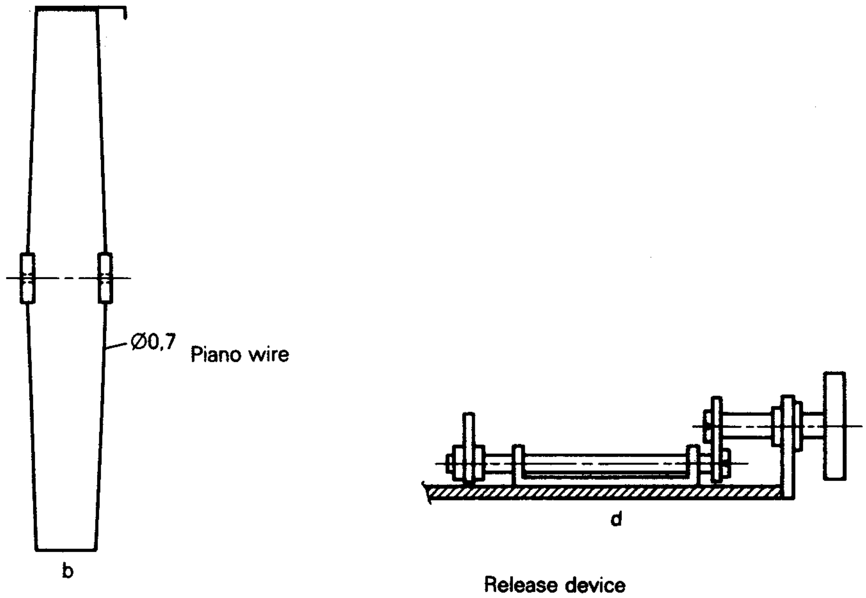
a is the bearing
b is the drag pointer
c is the release base
d is the release device

Fig. 4. – Calibration device.



Bearing

Release base



Release device

Drag pointer

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Dimensions in millimetres.

FIG. 5. – **Details of the calibration device.**

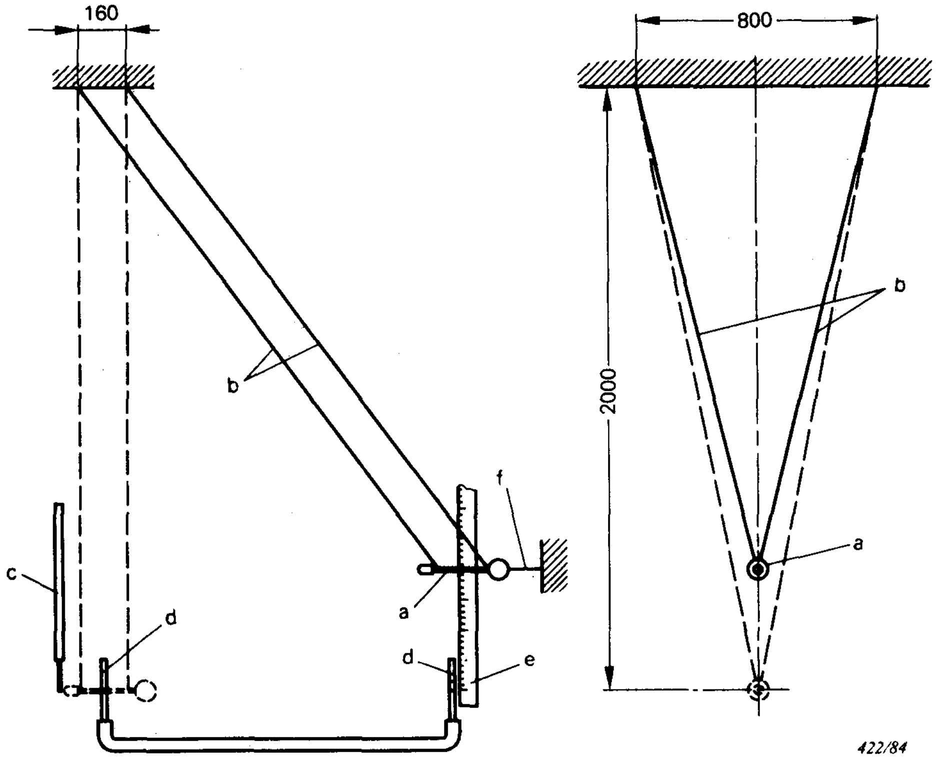

FIG. 6. – Arrangement for the calibration of the calibration device.

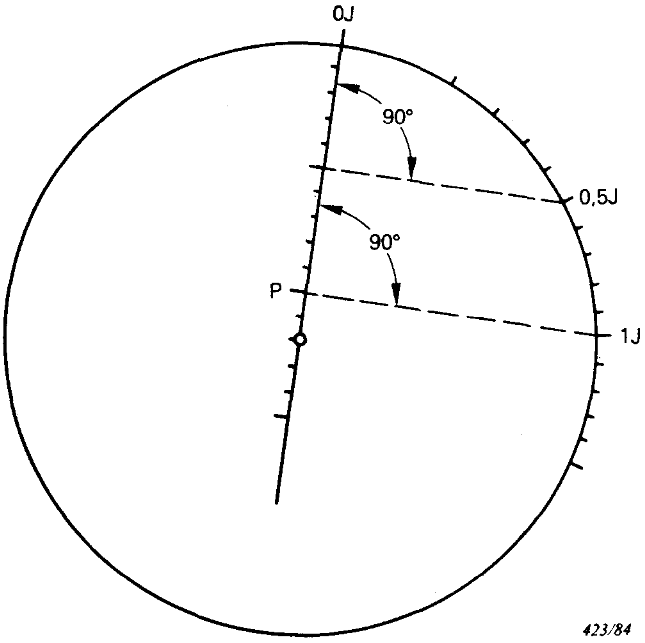

FIG. 7. – Division of scale plate.

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